

Discriminative Reconstruction Constrained Generative Adversarial Network for Hyperspectral Anomaly Detection

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Abstract

The rich and distinguishable spectral information in hyperspectral images (HSIs) makes it possible to capture anomalous samples [i.e., anomaly detection (AD)] that deviate from background samples. However, hyperspectral anomaly detection (HAD) faces various challenges due to high dimensionality, redundant information, and unlabeled and limited samples. To address these problems, this article proposes an unsupervised discriminative reconstruction constrained generative adversarial network for HAD (HADGAN). Our solution is mainly based on the assumption that the number of normal samples is much larger than the number of abnormal ones. The key contribution of this article is to learn a discriminative background reconstruction with anomaly targets being suppressed, which produces the initial detection image (i.e., the residual image between the original image and reconstructed image) with anomaly targets being highlighted and background samples being suppressed. To accomplish this goal, first, by using an autoencoder (AE) network and an adversarial latent discriminator, the latent feature layer learns normal background distribution and AE learns a background reconstruction as much as possible. Second, consistency enhanced representation and shrink constraints are added to the latent feature layer to ensure that anomaly samples are projected to similar positions as normal samples in the latent feature layer. Third, using an adversarial image feature corrector in the input space can guarantee the reliability of the generated samples. Finally, an energy-based spatial and distance-based spectral joint anomaly detector is applied in the residual map to generate the final detection map. Experiments conducted on several data sets over different scenes demonstrate its state-of-the-art performance.